

# NUCLEAR SCIENCE AND ENGINEERING<sup>®</sup>

THE RESEARCH JOURNAL OF THE AMERICAN NUCLEAR SOCIETY

## ANS OFFICERS

Melvin J. Feldman  
*president*

Vincent S. Boyer  
*vice president/president elect*

Harry Lawroski  
*treasurer*

Raymond D. Maxson  
*assistant treasurer*

Octave J. Du Temple  
*executive director*

DIXON CALLIHAN, *Editor*

MELVIN L. TOBIAS, *Associate Editor*

MARGE WILLIAMS, *Administrative Assistant*

Union Carbide Corporation  
Nuclear Division  
Oak Ridge, Tennessee 37830

## ANS PUBLICATIONS STAFF

Norman H. Jacobson  
*publications manager*

Joann Hollensteiner  
*editorial coordinator*

Nancy Zacha Godlewski  
*copy editor*

Diane R. Wojciechowski  
*copy editor*

Siegfried H. Krapp  
*production manager*

## COMPOSITION

Beljan, Dexter, Michigan 48130

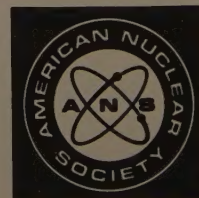
## Editorial Advisory Committee

Manson Benedict	A. F. Henry
E. Richard Cohen	A. A. Johnson
E. C. Creutz	C. H. Millar
Frank G. Dawson	L. W. Nordheim
D. H. Gurinsky	Hugh C. Paxton
Fred W. Thalgott	

**Volume 57**  
**May, June, July,**  
**August 1975**

NUCLEAR SCIENCE AND ENGINEERING is published monthly by the American Nuclear Society, Inc., with executive and business offices at 244 East Ogden Avenue, Hinsdale, Illinois 60521 - telephone 312/325-1991. The subscription rate is \$45 per volume or \$120 for three volumes per calendar year; single copies are \$15 (special issues slightly higher). Address subscription order to the publisher. (Back issues of Volumes 1-17 are available from Academic Press, 111 Fifth Avenue, New York,

New York 10003.) Second-class postage is paid at Hinsdale, Illinois, and at additional mailing offices. Printed in Danville, Illinois 61832, by Interstate Printers and Publishers, Inc. Copyright ©1975 by the American Nuclear Society, Inc. Inquiries about the distribution and delivery of NUCLEAR SCIENCE AND ENGINEERING and requests for changes of address should be directed to the American Nuclear Society. Allow 6 weeks for a change to become effective.



# NUCLEAR SCIENCE AND ENGINEERING

THE RESEARCH JOURNAL OF THE AMERICAN NUCLEAR SOCIETY

DIXON CATHIAN, Editor

MELVIN L. TORRES, Associate Editor

MARGE WILLIAMS, Administrative Assistant

Union Carbide Corporation  
Nuclear Division  
Danbury, Connecticut 06810

Editorial Advisory Committee

W. J. ...  
J. ...  
D. ...  
D. ...  
D. ...

AND OPERATIONS

... ..

...

...

...

...

...

...

...

...

...

...

...

AND PUBLICATIONS STAFF

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

...

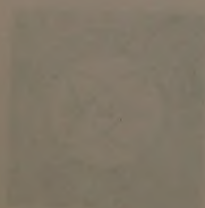
...

Copyright © 1975 by American Nuclear Society, Inc., Hinsdale, Illinois 60521

Volume 27

May, June, July

August 1975



THE AMERICAN NUCLEAR SOCIETY, INC.  
HINSDALE, ILLINOIS 60521  
TELEPHONE (312) 351-1000  
CABLE ADDRESS: ANS, CHICAGO, ILL.  
POSTAL ADDRESS: 111 Fifth Avenue, New York, N.Y. 10003

NUCLEAR SCIENCE AND ENGINEERING  
This journal is devoted to the publication of original research papers and technical reports in the field of nuclear science and engineering. It covers all aspects of nuclear energy, including nuclear power, nuclear medicine, nuclear weapons, and nuclear safety. The journal is published quarterly by the American Nuclear Society, Inc. and is one of the leading sources of information in the field.



# Contents of Volume 57

VOLUME 57, NUMBER 1, MAY 1975

## TECHNICAL PAPERS

- |    |  |  |
|----|--|--|
| 1  | A Technique for Calculation of Continuum Photon and Conversion-Electron Production Cross Sections and Spectra from Neutron-Induced Reactions | <i>S. T. Perkins, R. C. Haight,<br/>R. J. Howerton</i> |
| 12 | Total Neutron Cross Section of Hydrogenated Terphenyls for Neutron Energies Between 0.002 and 1.6 eV   | <i>H. A. Robitaille, J. S. Hewitt</i>                  |
| 18 | Fission Cross Section of Uranium-235 from 3 to 20 MeV  | <i>J. B. Czirr, G. S. Sidhu</i>                        |
| 28 | Combined Space-Time Effects of Xenon Transients and Reactor Control During Load Following in a Pebble-Bed High-Temperature Reactor           | <i>A. Lauer, W. Fröhling</i>                           |
| 39 | A Multilevel Approach to Nuclear Fuel Burnup Optimization  | <i>W. Ciechanowicz</i>                                 |
| 53 | A New Method for the Numerical Solution of the Two-Dimensional Neutron Diffusion Equation  | <i>Katsutada Aoki,<br/>Makoto Tsuiki</i>               |
| 63 | Thermal-Neutron Transport Processes in Heavy Water in the Temperature Range of 253 to 4 K  | <i>G. S. Gangwani, S. P. Tewari,<br/>L. S. Kothari</i> |

## TECHNICAL NOTES

- |    |  |  |
|----|--|--|
| 75 | Influence of Deep Minima on Multigroup Cross-Section Generation  | <i>Martin Becker</i>                           |
| 78 | Mean-Chord-Length Approximations in the Interface-Currents Formulation of the Collision-Probabilities Techniques | <i>J. M. Sicilian,<br/>M. M. Anderson, Jr.</i> |
| 81 | On the Treatment of First- and Last-Collision Effects in Neutron Age Theory                                      | <i>Gilbert Epstein,<br/>Martin Becker</i>      |
| 84 | Accurate Extrapolation Lengths for Pulsed Monoenergetic Neutrons in Slabs and Spheres                            | <i>N. G. Sjöstrand,<br/>E. B. Dahl</i>         |
| 86 | Some Additions to Reactor Noise Theory Which Include Delayed Neutrons  | <i>Hsiao-Kang Wang,<br/>Lawrence Ruby</i>      |

(Continued)

# Contents of Volume 57

Continued

VOLUME 57, NUMBER 1, MAY 1975

## (Continued)

- |    |   |   |
|----|---|---|
| 90 | An Examination of the Capabilities of the Phase Space<br>Time Evolution Method Applied to Neutron Transport                             | <i>Richard B. Jones,<br/>Morton Tavel</i> |
| 92 | Use of the Light-Water Neutron Scattering Kernel in the<br>Study of Neutron Transport Processes in Mixtures of<br>Light and Heavy Water | <i>S. P. Tewari</i>                       |

## COMPUTER CODE ABSTRACT

- |    |       |   |
|----|-------|---|
| 94 | TIGER | <i>J. A. Halbleib, Sr.,<br/>W. H. Vandevender</i> |
|----|-------|---|

## BOOK REVIEW

- |    |  |                      |
|----|--|----------------------|
| 96 | Nuclear Meteorology, K. P. Makhon'ko and S. G.<br>Malakhov, Eds. | <i>F. A. Gifford</i> |
|----|--|----------------------|



# Contents of Volume 57

Continued

VOLUME 57, NUMBER 2, JUNE 1975

## TECHNICAL PAPERS

- |     |  |  |
|-----|--|--|
| 97  | Pseudorandom Multifrequency Binary Sequence Testing and State Variable, Frequency Response Analysis of a Flux-Trap Type Reactor System | <i>W. Joe Gist,<br/>Stanley R. Bull,<br/>C. Leon Partain</i>                 |
| 117 | Reevaluation of the Emission Probabilities of Delayed Neutrons from Fission Products   | <i>T. Izak-Biran, S. Amiel</i>   |
| 122 | Comparison of the Cross-Section Sensitivity of the Tritium Breeding Ratio in Various Fusion-Reactor Blankets                           | <i>R. G. Alsmiller, Jr.,<br/>R. T. Santoro, J. Barish,<br/>T. A. Gabriel</i> |
| 129 | Structure Shielding Against Initial Radiations from Nuclear Explosions. I. Attenuation of Air Secondary and Fission Product Gamma Rays | <i>L. V. Spencer</i>   |
| 155 | Electromagnetic Self-Excitation in the Liquid-Metal Fast Breeder Reactor   | <i>E. S. Pierson</i>   |

## TECHNICAL NOTES

- |     |   |   |
|-----|---|---|
| 164 | Prediction of Cross Flow Due to Coolant Channel Blockages   | <i>William D. Brown,<br/>Ehsan U. Khan,<br/>Neil E. Todreas</i> |
| 169 | Developing Laminar Radial Velocity Profiles and Pressure Drop in the Entrance Region of Concentric Annuli | <i>J. E. R. Coney,<br/>M. A. I. El-Shaarawi</i>                 |

## BOOK REVIEW

- |     |   |                     |
|-----|---|---------------------|
| 175 | The Mobility and Diffusion of Ions in Gases, Earl W. McDaniel and Edward A. Mason | <i>Albert Simon</i> |
|-----|---|---------------------|

# Contents of Volume 57

Continued

VOLUME 57, NUMBER 3, JULY 1975

177 Editorial

*Dixon Callihan*

## TECHNICAL PAPERS

179 Generalized Continuous Neutron Slowing-Down Theory

*Takanobu Kamei*

188 Elliptical Toroidal Geometry—A Geometric Transport Correction

*G. C. Pomraning*

196 Energy-Dependent Applications of the Transfer Matrix Method

*Oktay I. Öztunali,  
Raphael Aronson*

205 Ray-Effect Mitigation in Discrete Ordinate-Like Angular Finite Element Approximations in Neutron Transport

*L. L. Briggs, W. F. Miller, Jr.,  
E. E. Lewis*

## TECHNICAL NOTES

218 A Method of Monte Carlo Fitting

*Gerald Klotzkin,  
Richard W. Swanson,  
Lawrence J. Harrison,  
Charles C. McPheeters*

222 An Analysis of Selected Fast Critical Assemblies Using ENDF/B-IV Neutron Cross Sections

*R. W. Hardie, R. E. Schenter,  
R. E. Wilson*

239 Albedo-Adjusted Fast-Neutron Diffusion Coefficients in Reactor Reflectors

*William B. Terney*

245 Exact Calculations of First Moment in a Simple Neutronic System

*Karmeshu, N. K. Bansal*

## LETTERS

248 Comments on Variational Theory and Generalized Perturbation Methods

*A. Gandini*

249 Response to "Comments on Variational Theory and Generalized Perturbation Methods"

*Weston M. Stacey, Jr.*

(Continued)

# Contents of Volume 57

Continued

VOLUME 57, NUMBER 3, JULY 1975

(Continued)

- |     |  |                      |
|-----|--|----------------------|
| 250 | Variational Versus Generalized Perturbation Theories—<br>Are They Different?               | <i>E. Greenspan</i>  |
| 251 | The Streaming Term of the Transport Equation in Terms<br>of General Orthogonal Coordinates | <i>Noel Corngold</i> |
| 252 | CORRIGENDUM  |                      |



# Contents of Volume 57

Continued

VOLUME 57, NUMBER 4, AUGUST 1975

253 Editorial: Critical Reviews

## CRITICAL REVIEW

255 Methods for Detailed Thermal and Hydraulic Analysis of Water-Cooled Reactors  
*Joel Weisman,  
Robert W. Bowring*

## TECHNICAL PAPERS

277 The Extended  $P_L$  Approximation of the Multidimensional Neutron Transport Equation  
*Beat Sigg*

292 Perturbation Theory for Charged-Particle Transport in One Dimension  
*John W. Wilson,  
Stanley L. Lamkin*

300 Measurements of the Neutron Capture Cross Sections of Gold-197 and Uranium-238 Between 20 and 3500 keV  
*W. P. Poenitz*

309 Gamma-Ray Production Cross Sections for Iron from 0.86 to 16.7 MeV  
*V. J. Orphan, C. G. Hoot,  
V. C. Rogers*

328 Experimental and Theoretical Studies of Criticality Safety by Ingress of Water in Systems with Pebble-Bed High-Temperature Gas-Cooled Reactor Fuel  
*V. Drüke, D. Filges,  
N. Kirch, R. D. Neef*

## TECHNICAL NOTES

333 A New Definition of the Cell Diffusion Coefficient  
*P. Köhler*

335 Uranium-238 to Uranium-235 Fission-Ratio Distribution in Spherical Lithium-Metal Assemblies With and Without a Graphite Reflector  
*Hiroshi Maekawa,  
Yasushi Seki, Toru Hiraoka,  
Masatoshi Moriyama*

340 Generalized Bilinear Weighting for Multigroup Cross-Section Collapsing  
*M. Salvatores*

(Continued)



# Contents of Volume 57

Continued

VOLUME 57, NUMBER 4, AUGUST 1975

(Continued)

## BOOK REVIEWS

- |            |   |  |
|------------|---|--|
| <b>345</b> | Annual Review of Nuclear Science  | <i>W. Bennett Lewis,<br/>Gordon C. Ball, H. C. Lee,<br/>I. S. Towner</i> |
| <b>347</b> | Energy: Demand, Conservation, and Institutional Problems, Michael S. Macrakis, Ed.  | <i>Vance L. Sailor</i>   |
| <b>348</b> | An Introduction to Fluid Mechanics and Heat Transfer, J. M. Kay and R. M. Nedderman | <i>Chen Ya Liu</i>   |
| <b>350</b> | <b>VOLUME 57 AUTHOR AND SUBJECT INDEXES</b>   |  |

